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Project Summary

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The University of Akron Urban Air Pollution and Human Health Study

Richard A. Mostardi, Daniel L. Ely, Nancy Woebkenberg, Mary Conlon, Marcia Jarrett, and Glen Atwood

Approximately 350 volunteers from East Cleveland, Ohio and 320 counterparts from Elyria, Ohio were studied for the chronic effects of air pollution. The East Cleveland area was chosen for its proximity to heavy industrial air pollution, and Elyria, because it is an urban area with an excellent past record for air quality.

Each volunteer submitted to pulmonary function tests; electrocardiogram at rest, exercise, and post exercise; trace element analysis in hair, blood, and urine; carboxyhemoglobin, methemoglobin and hormone assay in blood; and were asked to complete one epidemiological questionnaire.

During the duration of the work, air quality was monitored by two aerometric stations in each city using total suspended particulates (TSP), suspended sulfate (SO_4), suspended nitrate (NO_3), sulfur dioxide (SO_2), and nitrogen dioxide (NO_2) as criteria.

The results of this study indicate that there are some significant differences in the young age groups for lung function tests and questionnaire responses which favor Elyria residents. Differences are also found in the older groups, and while not as significant, favor the Cleveland residents. These results have many ramifications, the more obvious being that there is some selective migration associated with the Cleveland study area. It would appear that there may be an air pollution effect on the younger volunteers but more detailed study would be necessary for more definitive conclusions.

This Project Summary was developed by EPA's Health Effects Research Laboratory, Research Triangle Park, NC, to announce key findings of the research project that is fully documented in a separate report of the same title (see Project Report ordering information at back).

Introduction

Air pollution and its effects on human health have been a major concern of the scientific community for many years. The problem now seems to have been intensified in many areas of the United States as high sulfur coal, in its abundance, assumes a major role in energy production. Unfortunately, the release of sulfur containing compounds and suspended particulates is associated with the use of this natural resource, both of which either singly or in combinations have been shown to affect human health. The pressing question is, do sulfur oxides, suspended particulates, and perhaps nitrogen dioxide produce respiratory exacerbation and promote chronic obstructive respiratory disease (CORD) and if so what are the associated critical levels or concentrations?

Many studies conducted throughout the world have indicated that there is a strong relationship between reduced

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pulmonary function, CORD, and the sulfur oxide/particulate complex in adult populations. Other studies, however, have not shown such a strong relationship and suggest that the effects do not exist or are casual. The reason for such varied and divergent findings in studies dealing with CORD are many but could include the following: (1) population mortality—deaths in the study area associated with lung disorders, especially carcinomas and emphysema would preclude participation in the study; (2) population morbidity—more than likely, people suffering from CORD will leave the areas of high pollution either of their own recognizance or on the advice of a physician. This also precludes participation in a study of this type; (3) subject fear—many people will not volunteer for epidemiological studies of this type because they are aware of the hazards with air pollution, or may have a physical problem and are reluctant to have it diagnosed; (4) association with air pollution—people living adjacent to industrial complexes often work there or have relatives who work there. Therefore, these people will not volunteer for participation in air pollution studies because it is a controversial subject and generally feel that industry should not be subjected to more rigid pollution control legislation and enforcement; (5) acute variations in air pollutants—variations in the levels of air pollution can affect pulmonary function tests. Excessively high or low levels of air pollutants during or several days prior to pulmonary function testing can exert a considerable bias on single test, cross sectional study. Such effects must be monitored very closely; (6) variations in levels and types of pollution and meteorology—photochemical pollution problems are significantly different from sulfur oxide/particualte pollution and studies conducted in one environment are difficult to compare with those done in another; (7) people who live in a heavily polluted area frequently leave for extended periods of time during a given day. Many people also are employed outside of the residential area. Therefore, they are only exposed for a portion of the day which could exert considerable effects on epidemiological studies. (8) lack of standardization in data collection—different authors conduct differing lung function tests, making study comparisons quite difficult. Furthermore, some of the work is conducted with new or unique tests which do not withstand retesting and again are of limited value.

Two cities or parts of cities were selected for this study, one with high levels of industrial air pollution, the other with comparably low levels. The purpose of this work was to compare the measured air and health parameters on volunteer populations in these two cities. Of particular interest were the most chronic health effects. By measuring the air quality and determining pollution types and levels in the immediate area of the exposed populations and comparing these levels with standard, well-tested epidemiological methods it was felt that more definitive assessments of any observed health effects could be made.

Conclusions

Aerometric data between the two cities (Cleveland and Elyria) for the year 1977-78 did show some significant differences for SO_2 and NO_2. However, the values reported from each city were not abnormally high. For the year 1979, TSP and the respirable and nonrespirable fractions along with NO_2 showed significant differences. In each of the years, the Cleveland stations recorded the highest values for each of the variables.

The results of the data on the resident populations indicate that the young males and females (18-35) in Cleveland reported more chronic respiratory symptoms and showed a reduction in lung function efficiency indicated by pulmonary function testing. The older populations of males and females (50-75) were nearly identical with respect to reporting chronic respiratory symptoms but the older males and females in Elyria showed a tendency for reduced lung efficiency. On the basis of these results we suggest that a migration of the more susceptible individuals out of Cleveland is influencing the data and accounts for the observed differences.

Trace metal data between the two cities were similar and none of the mean values were abnormally high.

Carboxyhemoglobin (COHb) and methemoglobin (MetHb) data showed some interesting differences. COHb was significantly higher in both smokers and nonsmokers in Cleveland and is likely due to the heavy automobile traffic. MetHb was significantly higher in Elyria and was attributed to higher nitrate levels in the city water supply. COHb showed the usual smoking effects in both males and females in both cities.

The results of the ECG tests were subtle when the populations were broken down into age and sex groups. However, it appears that ECG variables are significant in predicting normal or abnormal vital capacity and forced expiratory volume in males and females in all age groups. These data illustrate the importance of studying the relationship between the respiratory and cardiovascular system in air pollution research.

Recommendations

Specific recommendations resulting from these data would be difficult to make. The study of the chronic effects of air pollution through the testing of volunteers permits limited statistical interpretation. More effective, would be evaluating the volunteers several times each year over the course of many years so that subtle trends could be more effectively identified. Such studies would require 10 to 20 years of study and would prove to be quite expensive.

The data collected in this study does effectively separate the populations between Cleveland and Elyria as a function of age; the questionnaire data as well as the pulmonary function data corroborate this. Whether or not these effects can be attributed directly to air quality cannot be determined at this time. It does appear, however, that selective migration of the populations could be in operation and contributing to the observed results.

Richard A. Mostardi, Daniel L. Ely, Nancy Woebkenberg, Mary Conlon, Marcia Jarrett, and Glenn Atwood are with the University of Akron, Akron, OH 44325.
***Wilson B. Riggan** is the EPA Project Officer (see below).*
The complete report, entitled "The University of Akron Urban Air Pollution and Human Health Study," (Order No. PB 81-213 282; Cost: $14.00, subject to change) will be available only from:
National Technical Information Service
5285 Port Royal Road
Springfield, VA 22161
Telephone: 703-487-4650
The EPA Project Officer can be contacted at:
Health Effects Research Laboratory
U.S. Environmental Protection Agency
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